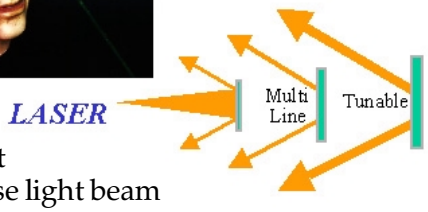
Nonlinear Optical Protective Barriers

Overview:

The synthesis, and characterization of nonlinear optical materials and the incorporation of the materials to optical systems is a part of Laser Eye Protection program whose goal is to increase the survivability and mobility of the land warrior where lasers are a part of the battlefield scenario. Laser eye protection at certain discrete wavelength is currently available. However, challenges still remain to extend mission operations to include low light conditions to provide the ability to complete a mission in an environment that involve not only more number and higher energies of lasers but of varieties of lasers with different wavelengths and pulse duration.



Description:

Some types of nonlinear optical material has characteristics that change the darkness of the material upon exposure to an intense light beam such as a focused laser beam. If a nonlinear material is in the glass however, a larger percentage of light energy is absorbed with light with higher intensity of light ordinary color glasses, on the other hand, will absorb a certain percentage of light at certain wavelengths. For the laser eye protection application light active media with a very fast response is required, a response as fast as a billionth down to almost a trillionth of second, because a pulsed laser can cause a damage just in that very short time frame. An example of light induced increase in absorption is found in currently available light active sun glasses in much longer response time. Research into nonlinear optical phenomena in materials and development of techniques to incorporate these materials into devices are being conducted for protection against lasers in any part of the visible spectrum.

Nonlinear optical materials such as the ones developed at Natick metal tetrabenzporphyrins (TBP) have been tested by Natick and a number of government and university laboratories showing promising characteristics of the darkening material or optical limiter. Although they are colored, they allow a wide range of wavelengths to pass through under ordinary light conditions for better visibility under normal conditions, but good blocking property upon exposure to a green laser pulse. The material is to be incorporated into a solid transparent material to be an optical system that being designed by Tank and Automotive RDEC (TARDEC) as a part of a joint Science and Technology Objective (STO). Improvement in the TBP performance as an optical limiter is being sought. Modifications in chemical structure and variation of host media are being studied in terms of their limiting effectiveness, stability, ease of synthesis, and photochemical properties. Other chemical systems for optical limiters besides TBPs are explored; they are polymethine dyes, phthalocyanines, and organic polymers.

Accomplishments:

Zn-methoxyphenyl TPB identified as curently useful candidate for optical limiter.

- Laser induced excited state of various TBPs characterized.

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